

*Conservation Assessment*  
*for*  
*Joor's Panicgrass*  
*(Dichanthelium commutatum subsp. jorii (Vasey) Freckmann & Lelong)*



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Prepared for the U.S.D.A. Forest Service, Eastern Region (Region 9), Shawnee and Hoosier National Forests

**INHS Technical Report 2007 (14)**

**Date of Issue: 14 March 2007**

Cover photo:

*Dichanthelium commutatum* (Schult.) Gould var. *commutatum*, from Biological Research Associates, Florida; photograph by Shirley Denton.

[http://www.biologicalresearch.com/Plants/web\\_small/d/dicha\\_com\\_frm86.jpg](http://www.biologicalresearch.com/Plants/web_small/d/dicha_com_frm86.jpg)

This Conservation Assessment was prepared to compile the published and unpublished information on the subject taxon or community; or this document was prepared by another organization and provides information to serve as a Conservation Assessment for the Eastern Region of the Forest Service. It does not represent a management decision by the U.S. Forest Service. Though the best scientific information available was used and subject experts were consulted in preparation of this document, it is expected that new information will arise. In the spirit of continuous learning and adaptive management, if you have information that will assist in conserving the subject taxon, please contact the Eastern Region of the Forest Service - Threatened and Endangered Species Program at 310 Wisconsin Avenue, Suite 580 Milwaukee, Wisconsin 53203.

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## ACKNOWLEDGMENTS

I would like to thank the staffs of the United States Forest Service, Shawnee and Hoosier National Forests, for the opportunity to compile these conservation assessments and for their invaluable assistance with data and field opportunities. Beth Shimp and Steve Widowski have been particularly helpful in facilitating these cost share agreements.

I would also like to thank the grants and contracts staff of the Illinois Natural History Survey and the University of Illinois, Champaign, for their assistance with logistics necessary to complete these reports.

Curators of several herbaria, cited in the appendices to this report, were very helpful in allowing access to the collections to obtain data on this plant. Several people also assisted by contributing information on this locally rare plant, including Mike Homoya in Indiana and Dan Spaulding in Alabama. Matthew Smith, of Silver Spring, MD, who has compiled an unpublished Atlas of the Plants of Maryland, provided information on the species distribution in that state. Kanchi Gandhi of Harvard University helped with a nomenclatural question on the subspecies epithet.

This material is based upon work supported by the U.S.D.A. Forest Service, Eastern Region, under Cost Share Award No. AG03-CS-11090804-024. Any opinions, findings, and conclusions or recommendations expressed in this publication are those of the author and do not necessarily reflect the views of the U.S.D.A. Forest Service, Eastern Region.

## EXECUTIVE SUMMARY

This Conservation Assessment is a review of the taxonomy, distribution, habitat, ecology, and status of the Joor's Panicgrass, *Dichanthelium commutatum* subsp. *joorii* (Vasey) Freckm. & Lelong, throughout the United States and Canada, and in the U.S.D.A. Forest Service lands, Eastern Region (Region 9), in particular. This document also serves to update knowledge about potential threats to, and conservation efforts regarding, Joor's Panicgrass to date. *Dichanthelium commutatum* subsp. *joorii* is only infrequently recognized as a distinct grass, and it has usually been thought of as a part of the variable species *Dichanthelium commutatum*. When considered distinct, it is defined as a clumped perennial grass up to approximately 0.5 meter tall with asymmetrical leaves, and it is normally found in moist or wet acidic soils in shade in wet forests and swamps in eleven states ranging from eastern Virginia south to Florida, Texas, and Mexico, with outlying populations north to southern Illinois and Arkansas. The plants have a spring-flowering stage and a morphologically different late summer and autumn flowering stage, and they have a wide-leaved basal rosette in the winter months. While normal wind-pollinated flowers are present in the spring, late summer flowers self-pollinate and normally do not open. The range of this grass is not completely known, because it is either identified incorrectly or it is not distinguished as distinct, and so it is generally not mapped. It is a subspecies that grows in moist or wet acidic soils in shade. It has been listed as Endangered only in Illinois, and as At Risk in only the Shawnee National Forest of Illinois. A great deal of additional research is needed to better evaluate the status and distribution of this grass.

In addition to species listed as endangered or threatened under the Endangered Species Act (ESA), or species of Concern by U.S. Fish and Wildlife Service, the Forest Service lists species that are Sensitive within each region (RFSS). The National Forest Management Act and U.S. Forest Service policy require that National Forest System land be managed to maintain viable populations of all native plant and animal species. A viable population is one that has the estimated numbers and distribution of reproductive individuals to ensure the continued existence of the entity throughout its range within a given planning area.

The objectives of this document are to:

- Provide an overview of the current scientific knowledge on the subspecies.
- Provide a summary of the distribution and status on the subspecies range-wide and within the Eastern Region of the Forest Service, in particular.
- Provide the available background information needed to prepare a subsequent Conservation Approach.

## NOMENCLATURE AND TAXONOMY

Scientific Name: *Dichanthelium commutatum* (Schult.) Gould subsp. *joorii* (Vasey) Freckmann & Lelong [2002]  
Common Names: Joor's Panicgrass; Joor's Panic Grass [*Dichanthelium commutatum* has been called: Variable Panicgrass, Variable Rosette Grass, and Variable Witchgrass.  
Synonymy: *Panicum joorii* Vasey [1889]  
*Panicum epilifolium* Nash [1899]  
*Dichanthelium joorii* (Vasey) Mohlenbr. [1985]  
  
Class: Liliopsida (Flowering Plants - Monocotyledons)  
Family: Poaceae (= Gramineae; The Grass Family)  
Plants Code: DIJO [also as DICO2 (*Dichanthelium commutatum*), PACOJ (*Panicum commutatum* var. *joorii*), and PAJO3 (*Panicum joorii*)] (USDA NRCS plant database, [W-1](http://plants.usda.gov/W-1))  
<http://plants.usda.gov/>

The grass genus *Dichanthelium* contains about 34 species in North America north of Mexico, according to Freckmann and Lelong (2003). The genus is of average to just above average size within the flowering plants with about 72 species worldwide. The species are limited to the Americas, and are most common in wet or moist, temperate to warm temperate regions of the Northern Hemisphere. *Dichanthelium* was segregated from the much larger, and very similar genus, *Panicum* first as a subgenus (*Panicum* subg. *Dichanthelium* Hitchc. & Chase [1910]) and subsequently as a genus (*Dichanthelium* (Hitchc. & Chase) Gould [1974]). A thorough review of this history, and support for the genus as being distinct, can be found in Aliscioni *et al.* (2003). The genus is placed within the grass subfamily Panicoideae tribe Paniceae.

Joor's Panicgrass was named *Panicum joorii* by Vasey [1889], based upon a specimen collected near Baton Rouge, Louisiana, by New Orleans (Tulane University) professor, physician, and botanist Joseph Finley Joor, hence the epithet *joorii*. In the subsequent years this species often has been considered to be a minor variant of *Panicum commutatum* Schult. (now *Dichanthelium commutatum* (Schult.) Gould) and it was usually combined with that, or it has been treated as a distinct species in the genus *Dichanthelium*, as *Dichanthelium joorii* (Vasey) Mohlenbr. Indeed, the epithet *commutatum* is Latin for 'changeable', revealing that the variable nature of this species has been known from its first naming. There has also been confusion in the spelling of the epithet, either as '*joori*' or '*joorii*'. This is a simple nomenclatural problem, correctable under the Code of Botanical Nomenclature, and its standard form must be '*joorii*' (K.Gandhi, pers. comm.). The taxon's status will probably be debated for many years to come, because its distinctness can be considered to fit within the overall known variability of *D. commutatum*, or it can be treated as an incipient geographically distinct species as subsp. *joorii*, or the characters can be emphasized to make it distinct at the specific level. This is a matter of taxonomic

opinion, and probably can only be resolved by some committee decision in the future. For now, many botanists in North America will use the name *Dichanthelium commutatum* subsp. *joorii* because this is how it appears in the *magnum opus* The Flora of North America, Volume 25 (Freckmann and Lelong 2003), the attempt to inventory all of the species of plants in North America north of Mexico. This is also the reason this name has been used here.

Joor's Panicgrass has been placed with three other subspecies of *D. commutatum* within *Dichanthelium* sect. *Macrocarpa* by Freckmann and Lelong (2003) along with the similar species *D. latifolium* (L.) Harvill, *D. boscii* (Poir.) Gould & Clark, and 2 other less widespread species. Hitchcock and Chase (1951) placed the species (as *Panicum joorii*) within *Panicum* subgenus *Dichanthelium* Section *Commutata* along with *Panicum ashei*, *Panicum commutatum*, *Panicum equilaterale*, and *Panicum mutabile*, all of which are also generally recognized as variants of *Dichanthelium commutatum*.

It is important to note that most summary lists of the plants of North America do not accept *Dichanthelium commutatum* subsp. *joorii* as different from *Dichanthelium commutatum*. This includes Kartesz and Meacham (1999) that was the basis for plant nomenclature for both the U.S. Department of Agriculture and the Nature Conservancy. Therefore, relatively little information has been compiled for this subspecies in the literature.

Because of the differing taxonomic philosophies and treatments of floristic botanists over the years, it is nearly impossible to determine from the literature the precise range of this plant. Illinois botanists have tended to accept its treatment as a species because of floras produced by Mohlenbrock (1986, 2002). Followers of the more conservative treatment of Gleason and Cronquist (1991) generally consider it to be a minor variant of *Panicum commutatum* Schult., and call it by that name. The most serious proponent and monographer of the genus *Dichanthelium*, Frank W. Gould, did not distinguish this grass from the variable *Dichanthelium commutatum* (Gould 1975, 1980).

Most species of both *Panicum* and *Dichanthelium* are simply called 'panic grass' or 'panicgrass' because of their similarity to one another. It is only in recent years that there has been an attempt to standardize the common names of the lesser-known species. In this case, the common name Joor's Panicgrass could apply to no other taxon. If it is included within *Dichanthelium commutatum*, that species is often called Variable Panicgrass.

## DESCRIPTION OF THE SUBSPECIES

*Dichanthelium commutatum* subsp. *joorii* is a perennial rhizomatous grass from a loose caudex or with knotty or loose rhizomes, and with slender decumbent or sprawling (widely spreading), glabrous, infrequently glaucous and / or purplish, **stems** (culms) usually 20 – 55 cm tall; the stems are usually unbranched in the spring (vernal) phase and in the autumnal phase there

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are more or less divaricate branches from all of the nodes, with the ultimate branches in short dense fascicles (densely fastigate); in the autumn phase the plants can be in dense tufts (densely cespitose); at least the lower internodes are purplish-red; the leaf sheaths are glabrous; the ligule is essentially obsolete; as in most other *Dichanthelium* species, and there is a winter rosette with shorter wider leaves than those of the later summer and autumn elongated stems; the **basal leaf blades** are large, cordate, basally ciliate, usually (6-) 8-14 (-15) cm long x 7-18 (-22) mm wide, and otherwise glabrous; the **stem leaf blades** are thin, 8-25 mm wide and 4-8 times longer than wide, ovate-lanceolate, scarcely cordate, often glaucous, glabrous, and strongly asymmetric-falcate; they are typically narrowed to the base. The **inflorescence panicles** are loosely flowered and 5-9 cm long, the spikelets of the primary panicle usually do not produce many seeds, the later small secondary panicles produce numerous cleistogamous flowers that produce the fruits. The **spikelets** are pubescent, 2.9 – 3.2 mm long and obovate to elliptic, and abruptly short-pointed. The lower glumes are about ¼ as long as the spikelets. The lower **lemmas** are pointed. The single upper floret, or **flower**, bears a pistil and three stamens, and each may produce a single seeded fruit, the caryopsis. The chromosome number is  $2n = 18$  for *Dichanthelium commutatum* and its subspecies (adapted from Hitchcock and Chase 1951 and Freckmann and Lelong 2003). An illustration of this subspecies can be found in Freckmann and Lelong (2003) p. 415. The typical subspecies is pictured on the cover page of this report.

Mohlenbrock (1986, 2002) distinguished what he called “*Dichanthelium joori*” from *Dichanthelium commutatum* by the following characters:

Spikelets 2.6-2.8 mm long, obtuse to subacute, blades firm, more or less cordate at base...*D. commutatum*.

Spikelets more than 2.8 mm long, abruptly short-pointed, blades thin, narrowed or slightly rounded at base...*D. joori*.

He also separated the rather similar *Dichanthelium clandestinum* from “*Dichanthelium joori*” by the following characters:

Culms and usually the sheaths papillose-hispid; spikelets subacute to acute...*D. clandestinum*.  
Culms and sheaths glabrous; spikelets abruptly short-pointed...*D. joori*.

Joor’s Panicgrass fits within the greater variation of *Dichanthelium commutatum* and it is closely related to the other subspecies. Its differences are subtle. It can generally be distinguished from subsp. *ashei* (T.G.Pearson ex Ashe) Freckmann & Lelong by the glabrous (or very sparsely pubescent?) culms (these are densely puberulent in subsp. *ashei*), by its larger spikelets (2.9-3.2 mm vs. 2.2-2.7 mm in subsp. *ashei*), by its thinner and longer stem leaf blades (> 8 cm long x 10 mm wide) and its larger rosette blades (some > 4 cm x 10 mm wide). It can be distinguished from the subsp. *equilaterale* (Scribn.) Freckmann & Lelong by its ovate-lanceolate and wider stem blades (4-8 X as long as wide and 6-25 mm wide vs. ca. 10 X as long as wide and 5-14

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mm wide, *i.e.* essentially linear in subsp. *equilaterale*) and by its glumes that are about ¼ as long as the spikelets *vs.* about ½ as long as the spikelets in subsp. *equilaterale*. While it is very similar to the typical subspecies, subsp. *joorii* can be distinguished from that by its decumbent or sprawling habit and loose rhizomes (*vs.* the erect stems and compact caudex in subsp. *commutatum*), by its asymmetric-falcate rather than symmetrical blades, by its glabrous rather than pubescent leaf sheaths, by its pointed rather than rounded lower lemmas, and by its slightly larger spikelets (2.9-3.2 mm *vs.* 2.6-2.9 mm in subsp. *commutatum*). The ranges of the subspecies overlap in much of the southeastern portion of the United States and south and intergradations among the subspecies are not uncommon (Freckmann and Lelong 2003).

Despite the differences in characters described above, many specimens of *Dichanthelium commutatum* can be separated to subspecies only with great difficulty, if at all.

## HABITAT AND ECOLOGY

A review of the literature demonstrates that this grass has a limited variety of plant associates and habitats throughout its range (Fernald 1950, Hitchcock and Chase 1951, Freckmann and Lelong 2003). *Dichanthelium commutatum* subsp. *joorii* grows mainly in low wet woodlands and swamps (Fernald 1950, Freckmann and Lelong 2003, Herkert and Ebinger 2002), and it is considered to be a coastal plain grass (Hitchcock and Chase 1951). It can grow in wet hammocks and swamps in south Florida (Wunderlin 1998). Little information is available concerning its soil or pH preferences, but it apparently prefers acidic silts, clays, sands, and humus, based upon its known range and habitats. This differs from the typical subspecies, *Dichanthelium commutatum* subsp. *commutatum*, that normally grows in drier, deciduous or mixed forests, thickets and openings, often in sandy or rocky open areas (Freckmann and Lelong 2003, Magee and Ahles 1999). It does appear that Joor's Panicgrass does indeed prefer, or is restricted to, wet habitats such as floodplain forests and swamps, while the other subspecies of the species tend to grow on well-drained upland slopes and drier, more exposed habitats. This habitat preference may help in separating Joor's Panicgrass from the other subspecies in the field.

Because this subspecies is not recognized as distinct in most official federal listings of the plants of North America, it has not been given an official wetland status. The overall and inclusive species, *Dichanthelium commutatum*, has been given the national wetland indicator status of FACU+ (Facultative Upland), and FAC (Facultative) indicating that the species is either usually found in non-wetlands (1% - 33 % probability of wetland occurrence) or that it is equally likely to occur in wetlands or non-wetlands. In Wetland Region 3, including both Illinois and Indiana, *Dichanthelium commutatum* has been specifically designated as an FAC species (equally likely to occur in wetlands or non-wetlands, probability 34% to 66 %; Reed 1988; [W-1](#); [W-2](#)). The subspecies *joorii*, however, is far more strongly correlated to wetlands than this overall species classification suggests, and it would appear that FACU+ and FAC would not strictly apply

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to this subspecies. It is more likely that Joor's Panicgrass would fit into the category of a FACW plant throughout its range (Facultative Wetland – usually occurs in wetlands, estimated probability 67 % - 99 %, but occasionally found in non-wetlands).

Because this grass has only rarely been distinguished from *Dichanthelium* (*Panicum*) *commutatum* in floras throughout its range, relatively little has been published concerning its ecology and plant associates. Until more fieldwork has been conducted on specific, identified populations, the ecology and lists of associates can only be the subject of partial speculation. Despite its known preference for wet habitats, this grass, surprisingly, is not included under any name in the generally extremely useful two-volume work on the aquatic and wetland plants of the southeastern United States by Godfrey and Wooten (1979) where Joor's Panicgrass appears to be most common. A few herbarium sheets have some very limited information on its preferred habitats and associates. Texas specimens suggest that it prefers deep shade in low woods in damp sand, often along creeks, while other labels indicate wet forested areas without describing the substrate.

In Illinois, Joor's Panicgrass grows in low swampy woods and floodplain forests at the southern tip of the state primarily in Johnson and Union counties (Mohlenbrock 1986, 2002, Herkert and Ebinger 2002, Shawnee National Forest 2005). Its associates here generally include the **trees** *Acer rubrum*, *Asimina triloba*, *Carya cordiformis*, *Celtis laevigata*, *Fraxinus pennsylvanica*, *Fraxinus profunda*, *Liquidambar styraciflua*, *Morus rubra*, *Nyssa sylvatica*, *Platanus occidentalis*, *Populus heterophylla*, *Quercus michauxii*, *Salix nigra*, *Taxodium distichum*, and *Ulmus americana*; the **shrubs** *Cornus stricta*, *Crataegus viridis*, *Itea virginica*, and *Lindera benzoin*; the **vines** *Campsis radicans*, *Clematis virginiana*, *Dioscorea villosa*, *Menispermum canadense*, *Passiflora lutea*, *Smilax bona-nox*, and *Smilax rotundifolia*; the **herbs** *Alisma subcordatum*, *Allium canadense*, *Arisaema dracontium*, *Armoracia lacustris*, *Asclepias perennis*, *Aster ontarionis*, *Aster simplex*, *Bidens discoidea*, *Boehmeria cylindrica*, *Boltonia asteroides*, *Cardamine bulbosa*, *Chaerophyllum procumbens*, *Cicuta maculata*, *Circaea lutetiana*, *Claytonia virginica*, *Commelina virginica*, *Corydalis flavula*, *Cryptotaenia canadensis*, *Galium aparine*, *Galium obtusum*, *Geum vernum*, *Heliotropium indicum*, *Hymenocallis caroliniana*, *Iris brevicaulis*, *Lysimachia ciliata*, *Lysimachia lanceolata*, *Myosotis macrosperma*, *Physostegia virginiana*, *Pilea pumila*, *Ranunculus abortivus*, *Ranunculus flabellaris*, *Ranunculus micranthus*, *Rorippa palustris*, *Ruellia strepens*, *Sanicula gregaria*, *Scrophularia marilandica*, *Senecio glabella*, *Sisyrinchium angustifolium*, *Sium suave*, *Stachys tenuifolia*, *Teucrium canadense*, *Viola missouriensis*, and *Viola striata*; the **graminoids** *Arundinaria gigantea*, *Carex amphibola*, *Carex blanda*, *Carex caroliniana*, *Carex crus-corvi*, *Carex grayi*, *Carex grisea*, *Carex intumescens*, *Carex louisianica*, *Carex rosea*, *Carex squarrosa*, *Carex tribuloides*, *Carex typhina*, *Chasmanthium latifolium*, *Cinna arundinacea*, *Dichanthelium clandestinum*, *Elymus virginicus*, *Glyceria striata*, *Leersia lenticularis*, and *Leersia virginica*; and the **ferns** *Athyrium filix-femina*, *Botrychium virginianum*, *Onoclea sensibilis*, and *Ophioglossum vulgatum*. These would be the expected associates in most portions of the range of this grass. The known populations of

this rare grass are located in the Southern Section of the Ozark Natural Division, the Southern Section of the Lower Mississippi River Bottomlands Division, and the Greater Shawnee Hills and Lesser Shawnee Hills Sections of the Shawnee Hills Natural Division of Schwegman *et al.* (1973) adjacent to the Bottomland Section of the Coastal Plain Natural Division (Herkert and Ebinger 2002). A specimen in the Illinois State Museum (collected by Paul Shildneck on 25 June 1976) said to be from Madison County, Illinois, may have been collected within the Northern Section of the Lower Mississippi River Bottomlands Natural Division.

One other area for which data is available on the plants associated with Joor's Panicgrass is in south Florida within Everglades National Park (Krauss 1987). *Dichanthelium commutatum* subsp. *joorii* (as *Panicum joorii*) was found in several test plots analyzed in that study, and its associates were determined to be the following vascular plants: the **trees** *Ficus aurea*, *Metopium toxiferum*, *Persea borbonia*, and *Salix caroliniana*, the **shrubs** *Ardisia solanacea*, *Baccharis halimifolia*, *Eugenia axillaris*, *Hypericum hypericoides*, *Ilex cassine*, *Myrica cerifera*, *Myrsine floridana*, *Psychotria sulzneri*, and *Tetrazygia bicolor*, the **vines** *Ampelopsis arborea*, *Mikania scandens*, *Parthenocissus quinquefolia*, *Toxicodendron radicans*, *Vitis aestivalis*, and *Vitis munsoniana*, the **forbs** *Boehmeria cylindrica*, *Crinum americanum*, *Diodia virginiana*, *Eupatorium coelestinum*, *Hydrocotyle verticillata*, *Hyptis alata*, and *Kosteletzkya virginiana*, and the **ferns** *Acrostichum danaeifolium* and *Thelypteris normalis*. With the exception of *Boehmeria cylindrica*, there is no overlap in the species associate lists from south Florida with that of southern Illinois.

## DISTRIBUTION AND ABUNDANCE

*Dichanthelium commutatum* subsp. *joorii* is relatively wide ranging, and this subspecies extends from the eastern United States south into Mexico (Freckmann and Lelong 2003). Its precise range is difficult to determine because of the fact that many botanists have not recognized it as distinct from the overall species itself.

Joor's Panicgrass itself is said to range, more specifically, from Mexico, Texas, and Florida north to Arkansas and Illinois, and northeast to eastern Virginia (Fernald 1950, Hitchcock and Chase 1951). Its known range, as reported in floras and elsewhere by those who have accepted this grass as distinct at some rank, includes 11 states, namely, Alabama, Arkansas, Florida, Georgia, Illinois, Louisiana, Mississippi, North Carolina, South Carolina, Texas, Virginia, and also into northeastern Mexico. Some authors have included the names *Panicum joorii* or *Dichanthelium joorii* as synonyms of *Panicum commutatum* or *Dichanthelium commutatum* within treatments of floras in other states, but this is misleading because no specimens of the more narrowly defined subspecies may be known from those states (*e.g.*, Magee and Ahles 1999). Therefore, while other states have included the name *Panicum joorii* or its equivalents as synonyms of the more widely distributed and more broadly defined species, it is uncertain if Joor's Panicgrass itself has ever been thought to occur in those states. Its precise range in Mexico is also obscure,

because it was not treated as distinct in a publication of the *Dichanthelium* species in Mexico (Gould 1980).

The overall, inclusive species *Dichanthelium commutatum* (s.l. [*sensu lato*]) has been reported from at least 28 states plus the District of Columbia, namely, Alabama, Arkansas, Connecticut, Delaware, District of Columbia, Florida, Georgia, Illinois, Indiana, Kentucky, Louisiana, Maine, Maryland, Massachusetts, Michigan, Mississippi, Missouri, New Jersey, New York, North Carolina, Ohio, Oklahoma, Pennsylvania, Rhode Island, South Carolina, Tennessee, Texas, Virginia, and West Virginia (W-1, W-3; Freckmann and Lelong 2003). It has also been found in Mexico (in the states of Mexico and Veracruz) and, possibly, even in Ecuador (Pichincha) (W-4). The distribution list above includes all of the subspecies and variants as a single taxon; the individual subspecies are not distinguished. The report of this species in Maine may be in error. It has not been included within Maine in several prominent floras for the region (Haines and Vining 1998, Magee and Ahles 1999, Seymour 1969).

In Illinois, where it is listed as Endangered, the subspecies (as a species) has been reported historically in Johnson and Union counties (Mohlenbrock 1986, 2002 – as *Dichanthelium joori*, Mohlenbrock and Ladd 1978 – as *Panicum joorii*; Herkert and Ebinger 2002 as *Panicum joori*; Illinois Endangered Species Protection Board 2005 as *Dichanthelium jorii*). There is also a specimen at the herbarium of the Illinois State Museum (ISM) bearing the name *Panicum jorii*, collected by Paul Shildneck on 25 June 1976 in Madison County, Illinois, ISM accession number 104239. The identification on this specimen has not yet been confirmed.

Joor's Panicgrass has not been found to occur in neighboring Indiana (Homoya, pers. comm., Deam 1940), Iowa, Kentucky, Missouri (Yatskievych 1999), Tennessee (Chester *et al.* 1993), or Wisconsin. It has been stated that the population in southern Illinois is disjunct (and isolated) by at least 300 miles from the next nearest population known (Herkert and Ebinger 2002; Shawnee National Forest 2005). Joor's Panicgrass would be expected to occur in nearby states, especially in Kentucky and Tennessee, and it has probably been overlooked because of a lack of critical study of the specimens from those states.

Joor's Panicgrass is at its northwestern limit of distribution in southern Illinois. Its northern limit appears to be in eastern Virginia. Its southern and western limits appear to be in Mexico, but which state is uncertain. As in the case with his treatment of the grasses of Texas, Gould placed *Panicum jorii* into synonymy with *Dichanthelium commutatum* in his treatment of the *Dichanthelium* species of Mexico (Gould 1980). That more inclusive species was said to range from the Texas border all the way south into Chiapas at rather high, cool, elevations in the eastern mountains.

Representative specimens of this grass in the United States have been listed in this report in Appendix 1. A summary of the distribution of Joor's Panicgrass in the United States,

though very imperfectly known, has been presented in Appendix 2. Included in this second appendix is the known county distribution in the United States for the overall species *Dichanthelium commutatum*, *sensu lato*, as well.

Within the U.S. Forest Service Eastern Region (Region 9) *Dichanthelium commutatum* subsp. *joorii* (as *Dichanthelium joorii*) is known to be present only within the Shawnee National Forest in Illinois (W-5). The subspecies has not been reported, as far as is known, in other National Forests within the United States, but it undoubtedly occurs in several, especially those on the coastal plain in the southern and southeastern states. It has been reported in Everglades National Park (Krauss 1987). As stated previously, its range is not well known because the subspecies is generally reported either as *Panicum commutatum* or as *Dichanthelium commutatum*, a widespread species overall, and few have investigated this plant as a distinct subspecies or species. The broadly defined species is known to be present in several National Forests in the eastern and southeastern United States.

Within the Shawnee National Forest in Illinois, Joor's Panicgrass has been found in the floodplain forest at LaRue – Pine Hills / Otter Pond Research Natural Area in Union County, at Bell Pond inside the Grantsburg Swamp Ecological Area, and in the state-managed Little Black Slough / Heron Pond along the Cache River in Johnson County (Shawnee National Forest 2005).

The populations in Illinois and other parts of the Midwest are isolated from one another as is typical for wetland species. There is little specific data available regarding population sizes. It is likely that the species was not common in the region at the time of European settlement because the amount of suitable habitat available then was also limited.

## PROTECTION STATUS

The Nature Conservancy has not ranked *Dichanthelium commutatum* subsp. *joorii*, because it has decided that it is not distinct from *Dichanthelium commutatum* (W-3). Therefore, there is no global, national, or state ranking available for Joor's Panicgrass. The grass has been listed as Endangered only in Illinois (as *Dichanthelium joorii* 'Panic Grass' - Illinois Endangered Species Protection Board 2005). The overall inclusive species *Dichanthelium commutatum* has been ranked, and its global ranking is G5 (Secure; W-6, Appendix 3). In the United States the overall species is given the National Heritage status rank of N5 with a similar meaning. The state rankings vary, and in most states the species is not ranked, but Joor's Panicgrass itself has been designated as Endangered in Illinois only, and the broadly defined species has not been designated as sensitive in any state.

Following Illinois' lead, *Dichanthelium commutatum* subsp. *joorii* (as *Dichanthelium joorii*) has been included on the Regional Forester Sensitive Species list (RFSS) for the Eastern Region, but it is classified to be 'At Risk' only on the Shawnee National Forest in Illinois (W-5).

Protection for this grass is currently dependent primarily on habitat protection, and so its survival will probably depend more on this than on species protection. Because this is generally considered to be a wetland grass, the protection of its wetlands may be sufficient for its protection. However, at several, perhaps many, of its known locations the habitat, while wet part of the year, may no longer qualify as a wetland by federal standards and it may not be protected in the long term.

Table 1 lists the official state rank assigned by each state's Natural Heritage program to the broadly defined species *Dichanthelium commutatum*, according to the Nature Conservancy at their Internet site ([W-3](#)). It should be noted that these do not specifically apply to subsp. *joorii*, which has no such ranking, but the table can serve as some guide for the overall species itself. Appendix 3 explains the meanings of the acronyms used ([W-6](#)). A summary of the current official protection status for the Variable Panicgrass [and **NOT** Joor's Panicgrass, except where noted] follows:

<u>U.S. Fish and Wildlife Service:</u>	Not listed (None)
<u>U.S. Forest Service:</u>	As <i>Dichanthelium joorii</i> , this grass is At Risk in the Shawnee National Forest only. <i>Dichanthelium commutatum</i> is not listed as sensitive.
<u>Global Heritage Status Rank:</u>	G5
<u>U.S. National Heritage Status Rank:</u>	N5

Table 1: S-ranks for *Dichanthelium commutatum*, s.l. [Heritage identifier: PMPOA24060]

<u>State/Province</u>	<u>Heritage S-rank</u>		
<b>UNITED STATES</b>		Indiana	SNR
		Kentucky	SNR
		Louisiana	SNR
		Maine	SNR
Alabama	SNR	Maryland	SNR
Arkansas	SNR	Massachusetts	SNR
Connecticut	SNR	Michigan	SNR
Delaware	S5	Mississippi	SNR
District of Columbia	SNR	Missouri	SNR
Florida	SNR	New Jersey	S4S5
Georgia	SNR	New York	S5
Illinois	S3 [subsp. <i>joorii</i> - Endangered]	North Carolina	S5
		Ohio	SNR

Oklahoma	SNR	Tennessee	SNR
Pennsylvania	SNR	Texas	SNR
Rhode Island	SNR	Virginia	S5
South Carolina	SNR	West Virginia	S5

## LIFE HISTORY

*Dichanthelium commutatum* subsp. *joorii* is a native perennial grass that lives to an unknown age. It is somewhat delicate, and so it may not be especially long-lived, but individual plants may continue to multiply by means of rhizomes or clump divisions for a considerable time. Colonies of the subspecies may be extensive locally. It appears to flower regularly, and, as in many other *Dichanthelium* species, the earliest flowering panicle appears to only infrequently produce significant numbers of mature fruits, while the later lateral and smaller panicles throughout the plant appear to produce cleistogamous flowers (flowers that do not open completely and which self-pollinate) in abundance that regularly and reliably produce viable fruits / seeds. The spring flowers are wind-pollinated as in almost all other grasses. The lack of mature fruits in many of these spring panicles may be due to the still-air habitat within floodplain forests and forested swamps that may prevent much successful pollen spread. Nothing is known concerning the success of establishment of new individuals from seed, nor about the genetic variability within or between colonies of this subspecies.

Joor's Panicgrass is a member of a group of plants that utilize a very efficient photosynthetic pathway called the C3 pathway, the initial fixation product of which is 3-phosphoglyceric acid (Brown and Smith 1975). Most plants, including the true genus *Panicum*, use a less efficient carbon production cycle called the C4 pathway. Grasses such as those in the genus *Dichanthelium* and many monocot and dicot weeds that utilize the C3 pathway tend to grow quickly and reproduce quickly and abundantly.

The typical *Dichanthelium* plant has two distinct growing phases. Growth in the spring is rapid from a basal rosette of rather wide, low leaves, and one relatively large panicle of flowers is produced at the tip of each tall stem (culm) produced from the rosette; there are normally multiple stems produced per clump. While these flowers are bisexual and a great deal of pollen is produced and released into the air, only a limited number of mature fruits are typically produced at this season. A second rapid flush of growth occurs in the late summer and autumn, generally after rains, and the original culms begin to branch and re-branch many times to produce a series of short clustered lateral and terminal stems that are often congested and broom-like and that each produce numerous small panicles in their axils. These panicles consist largely of flowers that are also bisexual but that do not completely open, but, instead, the pollen is released onto the stigma within its own flower, and most flowers result in mature fruits. These closed flowers are generally termed cleistogamous flowers, and the production of these many seeds insures the

propagation of the species.

These two flowering stages look quite different from one another, and the differences can present difficulties for many who attempt to identify these plants for the first time. In the spring, or vernal, phase one finds a plant with a conspicuous rosette of basal leaves, along with rather robust stems also with rather wide leaves, each stem terminating in a single easily seen panicle. The summer – autumn, or autumnal, phase plant has lost its basal rosette and has a multiplicity of broom-like fascicles of small branches with tiny panicles and numerous seeds that look only slightly like its earlier form. At the end of the season, a rosette again forms, and this basal rosette remains green throughout the winter, making and storing nutrition for a rapid flowering again the following spring. In order to flower successfully in the spring, this rosette must be kept free of debris such as leaf fall and snow in order to photosynthesize throughout much of the winter. *Dichanthelium commutatum* subsp. *joorii* is one of many species and subspecies that follow this typical life history pattern. This successful reproduction pattern usually results in a thriving colony of densely clumped individuals over time.

While Joor's Panicgrass produces some rhizomes as well, they are rather short and there is no evidence as yet that these act to allow the spread of the plant significantly by vegetative means. Theoretically, more plants can result from the separation of culms and rhizomes from one another resulting in vegetative reproduction. In the field, however, Joor's Panicgrass is usually found as separate, distinct, and very large mounded clumps rather than a series of small separated propagating individuals of a single clone. However, much is unknown about the life history involved with vegetative reproduction of this subspecies. Instead of vegetative reproduction, it is likely that this grass has spread very slowly throughout the southeastern states along slow-moving rivers by means of a gradual dispersal by flooding. The small smooth fruits have no known specialized dispersal mechanism.

Joor's Panicgrass has been found in flower as early as 18 February in southern Florida, but its vernal phase is more frequently seen from about 13 April to 1 June, quickly followed by mature fruits until about 30 July, by which time most vernal seeds or flowers have fallen. The fastigiated autumnal phase soon follows and the plants can continue to flower and fruit until a hard freeze in late September or early October stops them in the northern portions of its range. In southern Florida, plants remain fastigiated and in fruit well into January of the next year, drying rather than being killed by frost, until growth begins again with frequent rains. While the flowering time is generally given as May to August for this and other similar *Dichanthelium* species, the plants rarely fit a precise time frame overall. Herbarium specimens of *Dichanthelium commutatum* subsp. *joorii* were most frequently collected from 12-20 April (southern vernal phase), 1-16 June (northern vernal phase), 30 June – 30 July (both northern and southern vernal fruiting phase), and 1 September – 19 October (autumnal flowering and fruiting phase). Forty percent of the specimens were collected between 1 June – 30 July, and thirty-one percent were collected between 1 September – 19 October. In Illinois, the vernal specimens



examined were collected between 9 June and 5 July, and the single autumnal phase specimen seen was collected on September 16.

Based upon its phenology and known distribution, this grass appears to prefer and thrive in warm, moist weather or climates and its range appears to be limited by drought and by extreme cold. It does not appear to grow in strictly calcareous or basic soil habitats, it is not found in full sun, and it requires moist to wet soil all year.

## POPULATION BIOLOGY AND VIABILITY

*Dichanthelium commutatum* subsp. *joorii* flowers regularly, and according to the pattern described in the previous section, in Illinois and elsewhere throughout in its range. It appears to spread by means of seeds, but there may be some avenues for vegetative spread under some circumstances. However, there is no data on the success of either reproductive method for this subspecies. It is known, however, that while outcrossing can theoretically occur during the vernal phase of growth, most seeds are actually produced later in the season through a process of self-pollination and fertilization. This can lead to some serious reproductive problems caused by inbreeding.

It is generally understood that fertility is reduced in inbred populations through the process of autogamy (self-fertilization). Autogamy is useful to the plant when there are small numbers of individuals per area, since the safeguarding of the success of propagation is more important than the production of new genotypes. In primary habitats, *i.e.*, those that are generally poorly vegetated, initial success is very important. However, in subsequent periods of vegetation increase, pioneers are often substituted by other, more competitive species (W-7). In plants such as Joor's Panicgrass, self-fertilization is typical because there is almost no chance of fertilization by other individuals or genotypes. Not only does the pollen probably not disperse well by wind in its typical habitat, but also the majority of the fruits produced are the result of self-pollinating cleistogamous flowers with no outcrossing potential. It can be shown that existing populations are very isolated from one another because of the discontinuous nature of their habitat. Continued self-fertilization in such species can result in severe reproductive problems.

An example of negative effects thought to have arisen through isolation of populations can be seen in the case of another grass, Ofer Hollow Reedgrass (*Calamagrostis porteri* ssp. *insperata* (Swallen) C.W.Greene), which has become isolated on rather dry sandstone bluffs throughout its range. This grass almost never produces viable seed anywhere in its range and this reproductive failure may be a reflection of a high genetic load that has occurred as a result of its long isolation (see Hill 2003). High genetic load can be seen in dominant mutations that result in factors lethal to embryos, and this situation appears to be indicated in that grass. That plant survives as a rare relict in the vegetative state only.

There is no data at this time on the fertility of the seeds produced in the Illinois populations of Joor's Panicgrass. While it is a vulnerable species in Illinois, it does appear to be secure in other areas with suitable habitat remaining. Whether it persists or not in the future in areas where it is currently scarce appears to depend on the survival and maintenance of its habitat.

Joor's Panicgrass habitat has been observed to be decreasing (see Potential Threats below). It may or may not occur at other suitable sites in Illinois and neighboring states, but no known searches have been made specifically to find additional populations and to assess Joor's Panicgrass in recent years. Suitable habitat for the subspecies appears to exist, but it appears that it may have never been common here.

Maintaining the shaded floodplain or swamp habitat in which it grows appears to be one of the most important means to insure the survival (or viability) of this subspecies throughout its range. Its isolation and lack of specialized dispersal mechanisms appear to contribute to the very limited possibility for spread in *Dichanthelium commutatum* subsp. *joorii*. There appears to be little chance of natural colonization of new habitat by this grass. The long-term viability of this rare grass depends entirely on the protection and management of existing populations through human intervention.

## POTENTIAL THREATS

Globally, the status of Joor's Panicgrass has not been determined to be either secure or vulnerable because it is often not recognized to be a distinct taxon. Instead, it is usually considered to be a variant (and the name a synonym) of the widespread and variable *Dichanthelium commutatum*, known to be secure globally. This subspecies may, with further study, be found to be somewhat vulnerable once its range is more fully understood and once the true number of populations and individuals has been determined. Within Illinois, this grass has been judged to be vulnerable because it has a very limited state range and because there are few reported populations remaining. It appears to be unable to increase its range.

The primary threats to this subspecies include clear-cutting, grazing, recreational use of its habitat, and loss of habitat by its draining and conversion to primary agriculture (Shawnee National Forest 2005).

Clear-cutting in a floodplain or swamp forest habitat is generally known to dry out the understory present, especially in southern latitudes, and many of these understory plants, such as Joor's Panicgrass, can succumb to the sudden drying and exposure resulting from these activities. Complete clearing or cutting of a forest stand could not be enacted where a colony occurs without adverse effects. Subsequent grazing by livestock can then eliminate this grass from an area (Tilghman 1989). The panicoid grasses are sought out by grazing and foraging animals (Gould 1975).

The development of user-created trails are thought to pose only a minor threat to the few populations of this subspecies because its wetland habitat is not very popular with hikers and equestrians. Certainly any trampling or grazing of this rather delicate grass could quickly exterminate a small local population.

The most serious threat to this somewhat delicate understory grass is from changes in hydrology within its habitat. The draining of wetlands has been a serious threat to the native plants and animals in North America since the arrival of European settlers. Since settlement, much of the previously available habitat has been destroyed, converted to cultivated fields orchards or commercial forests, or has succumbed to land development (W-3). In more densely populated or industrialized areas, the lowering of the water table through the over utilization of water has had the same effect on wetlands.

Other threats may come from herbicide treatment along powerline clearings in the forested areas. The increased heat generated at open sites like these can severely suppress growth and prevent plant establishment as well. While overshading by woody species as forests mature is thought to be another potential threat to some understory plants, there is no data to support a loss of Joor's Panicgrass plants as a result of dense shading. *Dichanthelium* species often grow in areas nearly devoid of other vascular plants, and seem to grow well with ferns and sedges on moss carpets and on peaty hummocks in shade (pers. obs.). It is reasonable, then, to suggest that in its wetland environment, *Dichanthelium commutatum* subsp. *joorii* has not been dependent on fire management or on the presence of historic fires, but there is also no evidence to support the hypothesis that fires would hurt this grass either.

Joor's Panicgrass is not an aggressive or competitive grass. Competition from shade tolerant exotic plant species (such as the vine *Lonicera japonica* and the grass *Microstegium vimineum*) may pose a threat to this rare grass in some areas, especially where the habitat has become somewhat disturbed. These aggressive exotic species can form dense stands and eliminate ground layer herbaceous species including this grass. Furthermore, exotic vines and woody plants can threatened the hydrology of some wetland environments by causing rapid evaporative loss of the water, and this could pose a threat to this grass as well. If such exotic species do become a factor in suppressing this rare grass, some limited fire management may become necessary (Shawnee National Forest 2005).

It would appear because of the fragmentation and variable use of habitat resulting from a mix of public and private ownership that a strong effort should be made to add to the buffer around existing colonies and their habitats by purchasing nearby public lands as a means of protection for the habitat and the subspecies, where possible. It is suspected that this species is sensitive to cropland chemical runoff and that it requires unpolluted wetlands to survive (Shawnee National Forest 2005). Care would be needed to prevent such pollutants from entering the habitat of

Joor's Panicgrass.

It is generally believed among biologists that habitat fragmentation can have profound effects on the success and persistence of local populations. Over time, as populations become increasingly more isolated, the effects of fragmentation can potentially be observed at the molecular level by reduced genetic frequencies caused by random drift (Barrett and Kohn 1991). When one is considering populations that are already isolated, as in the case of the Illinois populations of this self-pollinating grass, random genetic drift may have already occurred and may have caused negative effects to the subspecies.

At the current time, it appears that the few populations of *Dichanthelium commutatum* subsp. *joorii* in the Shawnee National Forest are protected from habitat change and that they are likely to persist.

## RESEARCH AND MONITORING

Considerable research on Joor's Panicgrass is needed to gain a better understanding of it and its needs. At this time, one of the primary needs is to determine its current and historical range by the examination of herbarium specimens of this and similar species and subspecies that may have been incorrectly identified or that were collected before this subspecies was accepted as being distinct. Research needs include continued and additional searches for additional populations to re-evaluate the plant's status. Fieldwork is an integral part of this.

Research is needed on the basic life history of this grass. Little basic information is known concerning the life history of the plant, and specific details are not known concerning its fertility, dispersal mechanisms, germination and establishment requirements, growth rates, and genetic health (including variability). It would be useful to know how long the seeds are viable and how many must be in the seed bank to insure the survival of a colony. Also of major importance is basic data on how this grass responds to fire. Because some states have very few populations of this grass, caution is needed in field research to avoid harming the colonies. Some limited research on prescribed fire or selective thinning of the canopy should be conducted in order to determine the effects of increased light levels to the habitat and populations for the purpose of potentially better management (W-3). There is a need to determine the best habitat for the subspecies and how to best maintain the character of these areas (W-3).

Periodic monitoring is needed not only to supply data on its life history, but also to determine the threats to its habitat caused by water runoff and excess water, chemical pollutants in that runoff, edge effects such as drying, habitat destruction, and by exotic species wherever this species occurs. It is generally recommended that the habitat quality where this plant grows should be monitored on a regular basis and an assessment of the specific threats to all populations should be made (W-3; Webb *et al.* 1975). Long-term monitoring of known populations should be

conducted every 1-2 years to track their status with respect to these current management activities. Population stability, reproduction, and vigor should all be monitored. While hydrology and humidity fluctuations are assumed to occur in its habitat, it is not known precisely how much fluctuation can occur without adversely affecting the plants. It is also not known how well this grass can be established in newly created forested sites, though it is probable that it could be successfully introduced to former sites as well as mitigation sites if necessary.

One important consideration, also, is the unknown effect of prolonged or continuous foraging on this grass by deer or other mammals. It is possible that it is selectively eaten – but there is no data to support this. An enclosure (animal exclosure) around a colony along with a careful inventory for several years would be a simple way to test this hypothesis (Tilghman 1989).

Previous research on other species in the vicinity of floodplains has shown that the conditions within entire watersheds where the plants grow must be taken into consideration (W-3). However, it is not known exactly how much disturbance can occur before an individual population is adversely affected, nor is it known how large a wetland is needed in its proximity to support a viable population. Monitoring of the nearby wetlands may assist in determining the health of each population once it is known exactly what the environmental parameters should be for optimal health.

Population data for this grass is made more difficult by the fact that it is difficult to identify, or distinguish, from related species and subspecies. Local species growing with it should all be identified and distinguished before any research on Joor's Panicgrass can begin. Positively identified clumps should be carefully marked with markers that will last long enough for repeating observations over several years. A mix-up in labels with other very similar species or subspecies in the same vicinity can result in useless data, and this could be an especially serious problem in studies of this grass. Once the plants are carefully identified and marked, then one can determine how many distinct plants actually occur at a given site. Subsequently, information can be gathered on how many genetically distinct individuals may actually occur at a site, as well as on seedling establishment and success. Only careful molecular investigation can ultimately determine the number of genotypes in any given population, and this data will be useful in determining the extent of population inbreeding and the degree of genetic variability present in the Illinois populations.

Periodic surveys will be needed to determine the health and productivity of the population by counting the numbers of individuals. This is the only means to determine population trends accurately (W-3). Reproductive success can be estimated by counting the number of fruiting stems or fruiting tufts produced each season because seedlings and young plants cannot easily be identified in the field. As part of the basic research on current populations of this species, data such as the counts of numbers of individuals present (or the area covered by the colony), the determination of the amount of yearly flowering and seed production that might occur, and an

assessment of recruitment rates are needed in order to monitor population dynamics and to assess the viability of the individual populations found. Individual plants should be monitored over time at each site for basic phenology data. Such basic facts as fungal associations (if any), longevity, and yearly variations in colony size over a long period are not precisely known.

*Dichanthelium commutatum* subsp. *joorii* is so poorly understood and ignored by all but a few skilled botanists that a primary emphasis should be to locate and vigorously protect all remaining populations. It is crucial, of course, to have the identifications confirmed by a specialist in the group. Similar habitat should be explored for the plant at its flowering and fruiting seasons. There are moderate areas of additional suitable habitat in southern Illinois where the grass could also exist. A tentative list of associates and indicator species has been compiled as a result of field studies in Illinois and other states (see Habitat section above). These indicator plants can be very useful in facilitating the discovery of additional populations of this grass. Fruiting material is normally needed for positive identification of this grass, but mature seeds may not be necessary. Particular attention should be made to search and / or monitor this grass at its peak period for fruiting in one's local area, normally in early June to early July for the spring phase, and in early to mid September for the autumnal phase. Because of the general difficulties in identifying this grass, voucher specimens should be made according to techniques described in Hill (1995) or other similar references. It is quite possible that populations of this species have been overlooked because of the difficulties in field identification as well as because of the lack of adequate voucher material with which to compare specimens.

Botanical surveys conducted by scientists from the Illinois Natural History Survey and elsewhere have shown repeatedly that with sufficient time and funding, and an experienced eye, many plants thought to be extirpated or else threatened or endangered occasionally can be found at additional locations (Hill 2002). These sorts of investigations have been important in that they have led not only to the de-listing of species once thought to be rare, but they have also resulted in the discovery of species previously unknown in the state. The U.S. Forest Service and other related agencies have done a fine job in the effort to preserve rare species with the resources that they have available. Much of the locating and monitoring of known populations of rare species in southern Illinois has been conducted by Forest Service biologists and students in cooperation with Illinois Department of Natural Resources personnel. However, a continuing problem is that there is neither sufficient funding nor are there enough botanists available to survey the immense area that needs to be covered in the monitoring of the large numbers of sensitive plants, including this one. It appears that a high priority should be given to the training and hiring of more qualified field botanists to achieve these goals.

Some populations of *Dichanthelium commutatum* subsp. *joorii* are being casually monitored currently by botanists working on behalf of the state Natural Heritage program in the areas where it is listed as endangered or at risk (Shawnee National Forest 2005; Herkert and Ebinger 2002).

## RESTORATION

There are no known restoration efforts being conducted on *Dichanthelium commutatum* subsp. *joorii* anywhere in its range and the restoration potential of this subspecies is largely unknown (W-3). Observations on this and related grasses have indicated that successful fruit production in this subspecies does occur, and that reproduction may be primarily by seed.

The generally recommended method to restore populations of this and other rare plants is to protect and manage their habitat. In the previous section, the protection of the hydrology was shown to be especially critical for the survival of this grass. Exotic and aggressive species should be eliminated from each site. This would entail physically pulling them out because it is very likely that herbicide application would eliminate this subspecies at a site as well. The use of controlled burns, the thinning of the overstory, and the thinning of competing understory species are as yet untested means of managing for this plant, and some caution should be given to these methods until more data has been obtained on their effects.

Restorations of any native plant species are recommended using only propagated material grown from native, local populations to avoid mixing genotypes not adapted to the local conditions and to avoid compromising the local gene pool. If this rule is not followed, the result is generally the loss of plants because they are not competitive under local conditions or the result could be the success of a plant or plants that cannot be considered truly native (considered by some to be a plant community reconstruction rather than a restoration). Local plants should be propagated for planting in such an effort. Grasses are normally easily propagated by means of fresh seeds and / or rhizome cuttings under controlled conditions.

This grass is not known in cultivation and it is not commercially available in this country.

In summary, the management for extant colonies of *Dichanthelium commutatum* subsp. *joorii* should include the monitoring and management of the hydrology within its habitat, the prevention of logging and recreational uses in its vicinity, the monitoring and possible exclusion of grazing and browsing mammals in its vicinity, the experimental investigation of management techniques such as the use of prescribed fire or the selective thinning of the canopy in order to maintain suitable light levels for growth and flowering, and the elimination of woody plant encroachment in the understory, particularly that of exotic species. Habitats also need protection from land development and from indiscriminate herbicide application as well as from possible agricultural chemical runoff that may pollute its habitat. At this time, with proper management, current populations should persist and they could even increase in size, but the establishment of additional populations will be only through active human efforts.

## SUMMARY

Joor's Panicgrass, *Dichanthelium commutatum* subsp. *joorii*, is only infrequently recognized as a distinct grass, and it has usually been thought of as part of the variable species *Dichanthelium commutatum*. When considered distinct, it is defined as a clumped perennial grass up to approximately 0.5 meter tall with asymmetrical leaves, and it is normally found in moist or wet acidic soils in shade in wet forests and swamps in eleven states ranging from eastern Virginia south to Florida, Texas, and Mexico, with outlying populations north to southern Illinois and Arkansas. The plants have a spring-flowering stage and a morphologically different late summer and autumn flowering stage, and they have a wide-leaved basal rosette in the winter months. While normal wind-pollinated flowers are present in the spring, late summer flowers self-pollinate and normally do not open. The range of this grass is not completely known, because it is either identified incorrectly or it is not distinguished as distinct, and so it is generally not mapped. It is a subspecies that grows in moist or wet acidic soils in shade. It has been listed as Endangered only in Illinois, and as At Risk in only the Shawnee National Forest of Illinois.

A great deal of additional research is needed to better evaluate the status and distribution of this grass. Suggested research priorities for this rare grass include attempts to locate additional populations, to determine population sizes and to set up long-term monitoring stations, and to determine, through controlled and cautious experimentation, the best management techniques to insure its survival and increase. Management through enforced protection of its habitat appears to be necessary to allow it to persist where it may occur.

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## APPENDIX 1

### Representative specimens of *Dichanthelium commutatum* subsp. *joorii* examined or cited in the literature

#### Herbaria:

ILLS = Illinois Natural History Survey, Champaign. ISM = Illinois State Museum, Springfield, Illinois. MISS = University of Mississippi, University, Mississippi. MO = Missouri Botanical Garden, St. Louis. US = U.S. National Herbarium, Smithsonian Institution, Washington, D.C.

**NOTE:** Few specimens in herbaria bear this name because subsp. *joorii* is rarely accepted as distinct; therefore, only those reliably thought to be this taxon are included below. Identifications may not be accurate in some cases, but it is thought that most are correct. MO specimens, for example, were filed within *Dichanthelium commutatum* (Schultes) Gould. Specimens that were annotated with the name '*joorii*' at any rank were recorded. Those annotated by Chase, of Hitchcock and Chase (1951) bear the initials "H&C" below and her annotation labels also included the note: "Revision of *Panicum*. Hitchcock & Chase". These were identified as *Panicum joorii* Vasey. In a few cases, an identification history has been provided. "det." = identified, or determined, by.

**ALABAMA:** CULLMAN CO., near Bridge, det.: H&C as *Panicum joorii* Vasey, 26 Sep 1898, Eggert s.n. (MO); **ETOWAH CO.**, Atalla, det.: H&C as *Panicum joorii* Vasey, 30 Jun 1897, Eggert s.n. (MO); **ST. CLAIR CO.**, near Springville, det.: Eggert as *Panicum joorii* Vasey, by H&C as *Panicum commutatum* Schult., by Gould & Clark as *Dichanthelium commutatum* (Schultes) Gould, 7 Jul 1898, Eggert s.n. (MO); **TUSCALOOSA CO.**, near Warrior River ca. 11 mi above Tuscaloosa, det.: *Panicum joorii* Vasey by Harper, 11 Aug 1934, Harper 3245 (MO).

**ARKANSAS:** ASHLEY CO., Beech Creek, Parkdale, det.: Demaree as *Panicum joorii* Vasey, 27 Sep 1937, Demaree 16358 (MO).

**FLORIDA:** BREVARD CO., Okeechobee region, det.: ? Fredholm as *Panicum joorii* Vasey, 18 Apr 1903, Fredholm 5805 (MO); Titusville, det.: Chase as *Panicum joorii* Vasey, 17 Sep 1907, Chase 4019 (MO); **COLLIER CO.**, Turner's River Hammock, det.: Moldenke as *Panicum joorii* Vasey, 18 Feb 1930, Moldenke 665 (MO); **COLUMBIA CO.**, det.: H&C as *Panicum joorii* Vasey, Jun-Jul 1898, Hitchcock s.n. (MO); **DADE CO.**, near the Miami River, det.: Small as *Panicum joorii* Vasey, 26 Nov - 30 Dec 1913, Small & Small 4514 (MO); Opa-Locka Hammock, det.: Moldenke as *Panicum joorii* Vasey, 25 Jan 1930, Moldenke 492 (MO); **LAKE CO.**, Eustis, det.: Hitchcock as *Panicum commutatum* Schult., by H&C as *Panicum joorii* Vasey, Jun-Jul 1894, Hitchcock s.n. (MO); **LEE CO.**, Palmetto Hammock, Alva, det:

Hitchcock as *Panicum commutatum* Schult., by H&C as *Panicum jorii* Vasey “not characteristic”, Jul – Aug 1900, *Hitchcock* 477 (MO); **MANATEE CO.**, Manatee, det.: Tracy as *Panicum commelinaefolium* Ashe, by H&C as *Panicum jorii* Vasey, 29 Nov 1902, *Tracy* 7382 (MO); **PASCO CO.**, Lake Jovita, det.: O’Neill as *Panicum jorii* Vasey, 20 Feb 1927, *O’Neill s.n.* (MO) **UNDETERMINED COUNTY**, “Florida”, det.: H&C as *Panicum jorii* Vasey, 1843, *Rugel* 351 (MO); “Florida”, det.: Chapman as *Panicum dichotomum* L. var. *nervosum* Ell. ?, by H&C as *Panicum jorii* Vasey, s.d., *Chapman* 9784 (MO).

**GEORGIA: BURKE CO.**, in Ogeechee River swamp, det.: H&C as *Panicum jorii* Vasey, 5 Jun 1901, *Harper* 767 (MO); **ECHOLS CO.**, SW side of Little River, 6.9 mi E of Lake Park, det.: Faircloth as *Panicum jorii* Vasey, 16 Jul 1965, *Faircloth & Dean* 2285, (MO); **SUMTER CO.**, near Leslie, det.: H&C as *Panicum jorii* Vasey, 23 Jul 1901, *Harper* 1106 (MO).

**ILLINOIS: JOHNSON CO.**, Lower Cache River Nature Area, Karnak 7.5 min. topographic quadrangle, 16 Sep 1989, *Winship* 1310 (ILLS); 5 Jul 1982, *White* (ISM); 9 Jun 1983, *White* (ISM); 13 Jun 1986, *Schwegman* (ISM); Bell Pond Natural Area, 23 May 1990, *Phillippe & Ulaszek* 14061 (ILLS); **MADISON CO.**, 25 Jun 1976, *Shildneck* (ISM);

**LOUISIANA: EAST BATON ROUGE PARISH**, near Baton Rouge, 1 Oct 1885, *Joor* 39 (US – Holotype of *Panicum jorii* Vasey).

**MISSISSIPPI: HARRISON CO.**, between Long Beach and Gulfport, det.: H&C as *Panicum jorii* Vasey, 19 Sep 1891, *Joor s.n.* (MO); Long Beach, det.: H&C as *Panicum jorii* Vasey, 2 Sep 1891, *Joor s.n.* (MO); Biloxi, det.: Tracy as *Panicum jorii* Vasey, by H&C as *Panicum commutatum* Schult., by Gould & Clark as *Dichantherium commutatum* (Schultes) Gould, 1 Sep 1898, *Tracy* 4575 (MO); **PEARL RIVER CO.**, 2 mi W of Picayune, 18 Apr 1965, *Sargent* 8573 (MISS); **PERRY CO.**, Along Tallahala Creek, Runnelstown, 4 May 1966, *Jones* 5188 (MISS).

**MISSOURI: DUNKLIN CO.**, Campbell, det.: Bush as *Panicum xanthophysum* Gray [1893], then Bush as *Panicum jorii* Vasey [1900], by H&C as *Panicum commutatum* Schult., by Gould & Clark as *Dichantherium commutatum* (Schultes) Gould, 12 Sep 1893, *Bush s.n.* (MO); Campbell, det.: Bush as *Panicum jorii* Vasey, by H&C as *Panicum commutatum* Schult., by Gould & Clark as *Dichantherium commutatum* (Schultes) Gould, 30 Jul 1895, *Bush* 748 (MO). Note: probably *D. commutatum commutatum*, not *D. commutatum jorii*

**SOUTH CAROLINA: AIKEN CO.**, Aiken, det.: Ravenel as *Panicum nervosum* Muhl., by H&C as “*Panicum jorii* Vasey ? - spikelets smaller than characteristic”, 1 Jun 1867, *Ravenel* 4 (MO [possible isoelectotype of *Panicum commutatum* var. *minor* Vasey]).

**TEXAS: BOWIE CO.**, near Texarkana, det.: as *Panicum commutatum* Schultes by Heller [1898], by ? as *P. commutatum* [1-11-02], as *P. jorii* [1-18-02], by H&C as *Panicum*

*commutatum* Schult., 11 Aug 1898, *Heller & Heller 4083* (MO); **BRAZORIA CO.**, plants of Brazos River, Columbia, det.: Bush as *Panicum commutatum* Schult., by H&C as *Panicum joorii* Vasey, 20 Apr 1900, *Bush 98* (MO); **BRAZOS CO.**, White's Creek, det.: Reverchon as *Panicum ashei* Pearson, by H&C as *Panicum joorii* Vasey, 4 Jul 1900, *Reverchon 1837* (MO); **HARRIS CO.**, det.: Tharp as *Panicum joorii* Vasey, 7 Sep 1926, *Tharp s.n.* (MO); Houston, det.: Reverchon as *Panicum commutatum* Schult., by H&C as *Panicum joorii* Vasey, 16 Jun 1903, *Reverchon 4134* (MO); Houston, det.: Ravenel as *Panicum scribnerianum*, by H&C as *Panicum joorii* Vasey, 13 Apr 1869, *Ravenel 18* (MO); **WOOD CO.**, Mineola, det.: Reverchon as *Panicum joorii* Vasey, apparently agreed to by H&C, 19 Oct 1900, *Reverchon 2233* (MO).



## APPENDIX 2.

### The Historic Distribution of *Dichanthelium commutatum* subsp. *joorii* and *D. commutatum* s.l. in the United States.

Information from herbarium specimens and the literature.

(If in > 10 counties, then only number of counties included.)

**NOTE:** \* = *D. commutatum* subsp. *joorii* probably present in this state. The lack of the ‘\*’ indicates that subsp. *joorii* has not been reported in the state, and its distribution is therefore not addressed. For each entry in the table, the distribution of *D. commutatum* subsp. *joorii* is indicated first; the overall distribution of *D. commutatum* s.l. is indicated next, with notes as appropriate. See notes provided in Appendix 1 for more detail.

STATE	COUNTIES	NOTES
*Alabama	subsp. <i>joorii</i> : Cullman, Etowah, St. Clair [?], Tuscaloosa; probably more. <i>Dichanthelium commutatum</i> s.l.: at least 28 cos. nearly throughout	W-1; W-3; Herbarium specimens
*Arkansas	subsp. <i>joorii</i> : Ashley. Probably more. <i>Dichanthelium commutatum</i> s.l.: reported from at least 47 cos., widely scattered, none distinguished as <i>joorii</i>	W-1; W-3; Herbarium specimens, Smith (1978) [as <i>P. commutatum</i> , incl. <i>P. joorii</i> as syn.]
Connecticut	<i>Dichanthelium commutatum</i> s.l.: at least seven cos., excl. Tolland Co.	W-1; W-3.
Delaware	<i>Dichanthelium commutatum</i> s.l.: New Castle, Sussex.	W-1; W-3.
District of Columbia	<i>Dichanthelium commutatum</i> s.l.: present	W-1; W-3.
*Florida	subsp. <i>joorii</i> : Uncertain, probably at least in Brevard, Collier, Columbia, Dade, Lake, Lee, Manatee, Monroe, and Pasco. May actually be present in most cos. <i>Dichanthelium commutatum</i> s.l.: Uncertain, but listed in 60 counties by W-4	W-1; W-3; W-4; Herbarium specimens; includes Everglades National Park.
*Georgia	subsp. <i>joorii</i> : Burke, Echols, Sumter – probably more. <i>Dichanthelium commutatum</i> s.l.: > 45 cos., widely scattered	W-1; W-3; Herbarium specimens.

*Illinois	subsp. <i>joorii</i> : Johnson, Madison, Union; <i>Dichanthelium commutatum</i> s.l.: Alexander, Clark, Gallatin, Hardin, Jackson, Johnson, Massac, Pope, Pulaski, Union, Washington, Williamson. Specimens need to be re-examined !	W-1; W-3; Herbarium specimens; Herkert and Ebinger (2002) [as <i>Panicum</i> <i>joorii</i> ]; Mohlenbrock and Ladd (1978); Mohlenbrock (1986) [as <i>D. joorii</i> ]; includes Shawnee N.F.
Indiana	<i>Dichanthelium commutatum</i> s.l.: 21 cos., mostly southern third of state.	W-1; W-3; subsp. <i>joorii</i> is not in Indiana (M. Homoya, pers. comm.); Deam (1940).
Kentucky	<i>Dichanthelium commutatum</i> s.l.: at least 50 cos., widely scattered.	W-1; W-3.
*Louisiana	subsp. <i>joorii</i> : East Baton Rouge Parish; <i>Dichanthelium commutatum</i> s.l.: apparently occurs in every parish.	W-1; W-3; Herbarium specimens. MacRoberts (1989) [as <i>D. commutatum</i> ]; Thomas and Allen (1993) [as <i>Panicum commutatum</i> ]
Maine	<i>Dichanthelium commutatum</i> s.l.: unknown	W-1; W-3; not in Maine according to Magee and Ahles (1999)
Maryland	<i>Dichanthelium commutatum</i> s.l.: 18 cos., essentially absent from most of eastern shore	W-1; W-3; Smith (unpublished atlas).
Massachusetts	<i>Dichanthelium commutatum</i> s.l.: Barnstable, Berkshire, Dukes, Essex, Middlesex, Norfolk, Worcester	W-1; W-3; Magee and Ahles (1999) [as <i>Dichanthelium</i> <i>commutatum</i> ]
Michigan	<i>Dichanthelium commutatum</i> s.l.: Allegan, Berrien, Ingham, Kalamazoo, Kent, Muskegon, Ottawa, Wayne	W-1; W-3; Voss (1980)
*Mississippi	subsp. <i>joorii</i> : Harrison, Pearl River, Perry; probably more. <i>Dichanthelium commutatum</i> s.l.: 44 cos., widespread.	W-1; W-3; Herbarium specimens.
Missouri	subsp. <i>joorii</i> : possibly Dunklin. <i>Dichanthelium commutatum</i> s.l.: is in > 30 cos.]	W-1; W-3; Herbarium specimens. Yatskievych (1999)
New Jersey	<i>Dichanthelium commutatum</i> s.l.: 13 cos., mostly southern.	W-1; W-3.
New York	<i>Dichanthelium commutatum</i> s.l.: 14 cos., lacking in northeast	W-1; W-3.

*North Carolina	subsp. <i>joorii</i> : Uncertain distribution. <i>Dichanthelium commutatum</i> s.l.: is in > 50 cos., essentially throughout	W-1; W-3; Radford <i>et al.</i> (1968) [as <i>Panicum commutatum</i> ]; Herbarium specimens
Ohio	<i>Dichanthelium commutatum</i> s.l.: 17 cos., eastern and southern.	W-1; W-3.
Oklahoma	<i>Dichanthelium commutatum</i> s.l.: McCurtain, Nowata, probably more.	W-1; W-3.
Pennsylvania	<i>Dichanthelium commutatum</i> s.l.: > 35 cos., mostly southern	W-1; W-3; Wherry <i>et al.</i> (1979); Rhoads and Block (2000) [both sources as <i>Panicum commutatum</i> , or <i>P. commutatum</i> var. <i>commutatum</i> , only]
Rhode Island	<i>Dichanthelium commutatum</i> s.l.: Providence, Washington	W-1; W-3; Magee and Ahles (1999) [as <i>Dichanthelium commutatum</i> ]
*South Carolina	subsp. <i>joorii</i> : Aiken; probably many others. <i>Dichanthelium commutatum</i> s.l.: in every county [Radford had no vouchers for 4 cos.]	W-1; W-3; Radford <i>et al.</i> (1968); Herbarium specimens
Tennessee	<i>Dichanthelium commutatum</i> s.l.: in nearly every county [> 50 cos., as <i>P. commutatum</i> var. <i>commutatum</i> ]	W-1; W-3; Chester <i>et al.</i> (1993).
*Texas	subsp. <i>joorii</i> : Bowie, Brazoria, Brazos, Harris, Lamar, Wood, probably others. <i>Dichanthelium commutatum</i> s.l.: > 28 cos., mostly southeastern.	W-1; W-3; Herbarium specimens.
*Virginia	subsp. <i>joorii</i> : <i>Dichanthelium commutatum</i> s.l.: essentially every county.	W-1; W-3.
West Virginia	<i>Dichanthelium commutatum</i> s.l.: at least 32 cos., widespread.	W-1; W-3.

## APPENDIX 3.

### Natural Diversity Database Element Ranking System

Modified from: <http://www.natureserve.org/explorer/ranking.htm> [W-6]

#### Global Ranking (G)

##### G1

**Critically imperiled world-wide.** Less than 6 viable elements occurrences (populations for species) OR less than 1,000 individuals OR less than 809.4 hectares (ha) (2,000 acres [ac]) known on the planet.

##### G2

**Imperiled world-wide.** 6 to 20 element occurrences OR 809.4 to 4,047 ha (2,000 to 10,000 ac) known on the planet.

##### G3

**Vulnerable world-wide.** 21 to 100 element occurrences OR 3,000 to 10,000 individuals OR 4,047 to 20,235 ha (10,000 to 50,000 ac) known on the planet.

##### G4

**Apparently secure world-wide.** This rank is clearly more secure than **G3** but factors exist to cause some concern (i.e. there is some threat, or somewhat narrow habitat).

##### G5

**Secure globally.** Numerous populations exist and there is no danger overall to the security of the element.

##### GH

**All sites are historic.** The element has not been seen for at least 20 years, but suitable habitat still exists.

##### GNR

**Not ranked globally.** The element is not known sufficiently or there is some question as to its ranking at the current time.

##### GX

**All sites are extirpated.** This element is extinct in the wild.

##### GXC

**Extinct in the wild.** Exists only in cultivation.

## G1Q

**Classification uncertain.** The element is very rare, but there is a taxonomic question associated with it.

## National Heritage Ranking (N)

The rank of an element (species) can be assigned at the national level. The **N-rank** uses the same suffixes (clarifiers) as the global ranking system above. **NNR** = not ranked nationally.

## Subspecies Level Ranking (T)

Subspecies receive a **T-rank** attached to the G-rank. With the subspecies, the G-rank reflects the condition of the entire species, whereas the T-rank reflects the global situation of just the subspecies or variety. **TNR** = not ranked at the taxonomic level in question.

For example: *Chorizanthe robusta* var. *hartwegii*. This plant is ranked **G2T1**. The G-rank refers to the whole species range (*i.e.*, *Chorizanthe robusta*, whereas the T-rank refers only to the global condition of var. *hartwegii*. Otherwise, the variations in the clarifiers that can be used match those of the G-rank.

## State Ranking (S)

### S1

**Critically imperiled.** Less than 6 element occurrences OR less than 1,000 individuals OR less than 809.4 ha (2,000 ac). **S1.1** = very threatened; **S1.2** = threatened; **S1.3** = no current threats known.

### S2

**Imperiled.** 6 to 20 element occurrences OR 3,000 individuals OR 809.4 to 4,047 ha (2,000 to 10,000 ac). **S2.1** = very threatened; **S2.2** = threatened; **S2.3** = no current threats known.

### S3

**Vulnerable.** 21 to 100 element occurrences OR 3,000 to 10,000 individuals OR 4,047 to 20,235 ha (10,000 to 50,000 ac). **S3.1** = very threatened; **S3.2** = threatened; **S3.3** = no current threats known.

### S4

**Apparently Secure.** This rank is clearly lower than S3 but factors exist to cause some concern (*i.e.*, there is some threat, or somewhat narrow habitat).

## **S5**

**Secure.** Demonstrably secure to ineradicable in the state.

## **SH**

**All state sites are historic;** the element has not been seen for at least 20 years, but suitable habitat still exists. Possibly extirpated.

## **SNR, SU, S?**

Reported to occur in the state. Otherwise not ranked.

## **SX**

All state sites are extirpated; this element is extinct in the wild. Presumed extirpated.

## **Notes:**

1. Other considerations used when ranking a species or natural community include the pattern of distribution of the element on the landscape, fragmentation of the population/stands, and historical extent as compared to its modern range. It is important to take a bird's eye or aerial view when ranking sensitive elements rather than simply counting element occurrences.
2. Uncertainty about the rank of an element is expressed in two major ways: by expressing the rank as a range of values (*e.g.*, **S2S3** means the rank is somewhere between **S2** and **S3**), and by adding a '?' to the rank (*e.g.* **S2?**). This represents more certainty that the rank is **S2** than **S2S3**, but less certainty than **S2** alone.